

Notice of Allowability

Application No.

09/254,521

Examiner

Hoa Q. Pham

Applicant(s)

HIGGS ET AL.

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the amendment filed on 9/19/05.
2. ☒ The allowed claim(s) is/are 1-20.
3. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☒ All b) ☐ Some* c) ☐ None of the:
 1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☒ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☒ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☒ to Paper No./Mail Date 1/5/00.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08),
Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413),
Paper No./Mail Date attached.
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

EXAMINER'S AMENDMENT

1. With respect to the new Revised Amendment Practice effective August 12, 2004, the specification and claims are rewritten in the new format appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Mr. Paul Parker (Reg. No. 38,264) on 5/8/06.

2. The application has been amended as follows:

IN THE SPECIFICATON:

- A. Page 1, line 2; insert -- **BACKGROUND OF THE INVENTION** --
- B. Page 4, line 7; insert -- **SUMMARY OF THE INVENTION** --
- C. Page 5, line15; delete "R_{IT}" and insert -- R_{rr} --.
- D. Page 7, line13; delete "structutre" and insert --structure--.
- E. Page 10, line 4; insert -- **BRIEF DESCRIPTION OF THE DRAWINGS**--.
- F. Page 11, line 8; insert -- **DETAILED DESCRIPTION OF THE INVENTION** --.
- G. Page 13, line 17; insert --) -- after "26".
- H. Page14, line 3 and 17; delete "beamsplitter" and insert -- beam splitter --.

IN THE CLAIMS:

Claim 1. (currently amended) A method for identifying defects in a ~~semiconductor~~ or silicon structure comprising exposing said ~~semiconductor~~ or silicon structure to at least one high intensity beam of light characterised by a spot size of between 0.1 mm - 0.5 microns and a peak or average power density of between $10^4 - 10^9$ watts/cm²; and collecting luminescence from the ~~semiconductor~~ or silicon structure so as to visualize and observe defects in same by production of an image, characterized in that non-radiative recombination of electron pairs is detected as darkened regions in the image at the physical point of the defect.

Claim 2. (currently amended) A method according to claim 1 comprising selecting the wavelength of said light so as to identify defects at a selective depth in said ~~semiconductor~~ or silicon structure.

Claim 3. (previously presented) A method according to claim 1 wherein the high intensity beam of light is pulsed.

Claim 4. (previously presented) A method according to claim 1 comprising collecting luminescence from a series of focal planes.

Claim 5 (currently amended) An apparatus for undertaking photoluminescence imaging of a ~~semiconductor~~ or silicon structure characterised in that it comprises at least one high intensity light generating means which produces a beam of light having a spot size between 0.1 mm - 0.5 microns and a peak or average power density of between $10^4 - 10^9$ watts/cm²; a means for collecting luminescence from the ~~semiconductor~~ or silicon wafer structure and means for producing photoluminescence images of said ~~semiconductor~~ or silicon structure in the form of an image so as to

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visualize and observe any defects that may be present, characterized in that means for collecting photoluminescence enable detection of non-radiative recombination of electron pairs, as darkened regions in the image at the physical point of the defect.

Claim 6 (original) An apparatus according to claim 5 wherein said light generating means is provided with modulation means whereby the wavelength of said light beam can be selected.

Claim 7 (currently amended) An apparatus according to claims 5 ~~or 6~~ wherein said light generating means is provided with modulation means whereby the intensity of said light beam ~~may be~~ is selected.

Claim 8 (previously presented) Apparatus according to claim 5 wherein means is provided to enable the high intensity beam of light to be pulsed.

Claim 9 (currently amended) Apparatus according to claim 5 wherein said light generating means is provided with modulation means whereby the frequency of said light beam ~~may be~~ is selected.

Claim 10 (currently amended) Apparatus according to claim 5 wherein said apparatus comprises confocal optics whereby images of said ~~semiconductor or~~ silicon structure ~~may be~~ is obtained through a series of focal planes.

Claim 11 (previous presented) A method for identifying defects in a semiconductor other than a silicon structure (non-silicon semiconductor) comprising exposing said semiconductor to at least one high intensity beam of light characterized by a spot size of between 0.1 mm - 0.5 microns and a peak or average power density of between $10^4 - 10^9$ watts/cm²; and collecting luminescence from the semiconductor so

as to visualize and observe defects in same by production of an image, characterized in that non-radiative recombination of electron pairs is detected as darkened regions in the image at the physical position of the defect.

Claim 12 (previous presented) A method according to Claim 11 comprising selecting the wavelength of said light so as to identify defects at a selective depth in said semiconductor.

Claim 13 (previous presented) A method according to Claim 11 wherein the high intensity beam of light is pulsed.

Claim 14 (previous presented) A method according to Claim 11 comprising collecting luminescence from a series of focal planes.

Claim 15 (Currently amended) An apparatus for undertaking photoluminescence imaging of a semiconductor other than a silicon structure (non-silicon semiconductor) characterised in that it comprises at least one high intensity light generating means which produces a beam of light having a spot size between 0.1 mm - 0.5 microns and a peak or average power density of between $10^4 - 10^9$ watts/cm²; a means for collecting luminescence from said semiconductor, and means for producing photoluminescence images of said semiconductor in the form of an image so as to visualize and observe any defects that may be present, characterized in that means for collecting photoluminescence enable detection of non-radiative recombination of electron pairs, as darkened regions in the image at the physical point of the defect.

Claim16 (previous presented) An apparatus according to Claim 15 wherein said light generating means is provided with modulation means whereby the wavelength of said light beam can be selected.

Claim17 (currently amended) An apparatus according to Claim 15 wherein said light generating means is provided with modulation means whereby the intensity of said light beam ~~may be~~ is selected.

Claim 18 (previous presented) An apparatus according to Claim 15 wherein means is provided to enable the high intensity beam of light to be pulsed.

Claim 19 (currently amended) An apparatus according to Claim 15 wherein said light generating means is provided with modulation means whereby the frequency of said light beam ~~may be~~ is selected.

Claim 20 (currently amended) An apparatus according to Claim 15 wherein said apparatus comprises confocal optics whereby images of said semiconductor ~~or structure may be~~ is obtained through a series of focal planes. --

REASONS FOR ALLOWANCE

3. The following is an examiner's statement of reasons for allowance:

There was no prior art found by the examiner that suggested modification or combination with the cited art so as to satisfy the combination of all the limitations in claims 1, 5, 11 and 15.

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As to claims 1, 5, 11 and 15, Banerjee et al (U.S. Patent 6,075,592) is the closest reference found by examiner which teaches that the power density of the pump beam is $5 \times 10^4 \text{ W/cm}^2$ (column 3, lines 60-65) and the objective lens 140 focuses the pump beam to a 5 micrometer +/- 0.5 micrometer diameter spot (column 4, lines 17-20); however, Banerjee et al does not teach or suggest the limitation "characterized in that non-radiative recombination of electron pairs is detected as darkened regions in the image at the physical point of the defect" which recited in claims 1, 5, 11 and 15.

Therefore; the prior art of record, taken alone or in combination, fails to disclose or render limitations "characterized in that non-radiative recombination of electron pairs is detected as darkened regions in the image at the physical point of the defect", in combination with the rest of the limitations of claims 1, 5, 11 and 15.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

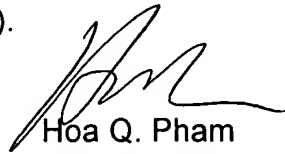
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hoa Q. Pham whose telephone number is (571) 272-2426. The examiner can normally be reached on 7:30AM to 6 PM, Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory J. Toatley, Jr. can be reached on (571) 272-2800 ext. 77. The fax

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phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Hoa Q. Pham
Primary Examiner
Art Unit 2877

HP
May 8, 2006